penndot > municipal services

Pocket Guide for Road Construction and Maintenance

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Bureau Contact Information

pennsylvania
DEPARTMENT OF TRANSPORTATION
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PART 1

Inspector's Job Guide for Highway & Street Construction

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Introduction

These guides are intended to cover the very basic duties of inspection by reference to key activities. The guides must be supplemented by reference to contract documents specifications, special provisions, instructional manuals, and guidance by the project engineer.

Duties Before Beginning Inspection

PA One Call, 1-800-242-1776, www. paonecall.org

1. Review plans, special provisions, Construction and Materials Manual, and specifications that apply to your assigned duties. Are all required permits obtained and copies onsite? PA One call notified? E&S controls in place?
2. Discuss your responsibility and authority with the project engineer who has day-to-day project responsibility.
3. Review the format and required content of your inspection diary.
4. Review required testing procedure and forms. Read the QC documents.
5. Discuss notification, changes, corrections, delays, rejections, tolerances, and checks with the project engineer.
6. **Ask Questions!** If you are not 100% sure of your duties, go over them again with the project engineer.

Safety

Review all operating procedures to assure that activities are performed in the safest manner. **Safety is everyone's responsibility!** When performing duties in the presence of traffic, review necessary traffic control requirements.

Uniform Color Code

(For Underground Utility Markings)

American Public Works Association

White:	Proposed Excavation.
Pink:	Temporary Survey Markings.
Red:	Electric Power Lines, Cables, Conduit and Lighting Cables.
Yellow:	Gas, Oil, Steam, Petroleum or Gaseous Materials.
Orange:	Communication, Alarm or Signal Lines, Cable or Conduit.
Blue:	Potable Water.
Purple:	Reclaimed Water, Irrigation and Slurry Lines.
Green:	Sewers and Drain Lines.

Wind Chill Equivalent Temperature

Dry Bulb Temperature (°F) \ Wind Velocity (M.P.H.)	4	5	10	15	20	25	30	35	40	45
45	45	43	34	29	26	23	21	20	19	18
40	40	37	28	23	19	16	13	12	11	10
35	35	32	22	16	12	8	6	4	3	2
30	30	27	16	9	4	-1	-2	-4	-5	-6
25	25	22	10	2	-3	-7	-10	-12	-13	-14
20	20	16	3	-5	-10	-15	-18	-20	-21	-22
15	15	11	-3	-11	-17	-22	-25	-27	-29	-30
10	10	6	-9	-19	-24	-29	-33	-35	-37	-38
5	5	0	-15	-25	-31	-36	-41	-43	-45	-46
0	0	-5	-22	-31	-39	-44	-49	-52	-53	-54
-5	-5	-10	-27	-38	-46	-51	-56	-58	-60	-62
-10	-10	-15	-34	-45	-53	-59	-64	-67	-69	-70
-15	-15	-21	-40	-51	-60	-66	-71	**-74**	**-76**	**-78**
-20	-20	-25	-46	-58	-67	**-74**	**-79**	**-82**	**-84**	**-85**
-25	-25	-31	-52	-65	**-74**	**-81**	**-86**	**-89**	**-92**	**-93**
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-40	-40	-47	-71	**-85**	**-95**	**-103**	**-109**	**-113**	**-115**	**-117**
-45	-45	-52	**-77**	**-92**	**-103**	**-110**	**-116**	**-120**	**-123**	**-125**

INCREASING DANGER

Flesh may freeze within 1 min.

GREAT DANGER

Flesh may freeze within 30 sec.

Plant Mix Bituminous Paving

1. Check equipment for specification compliance, and discuss paving and rolling sequence with contractor. Review all QC documents. Is a Pre-Pave meeting required?
2. Check that the surface is smooth, firmly compacted and at correct cross section, grade, and alignment. Existing bituminous and concrete bases are to be clean and free of loose material, and tacked. Excessive joint and crack sealing material should be removed. Pre-level all uneven surfaces.
3. Ensure that truck boxes are clean to prevent build-up (do not use kerosene, diesel fuel or fuel oil). Loads must be covered.
4. Check temperature frequently and be aware of the acceptable temperature range of mix.
5. Insure that scale inspector verifies and initials each delivery ticket, unless automated printer is used.
6. Check that paving inspector collects, checks, and initials each delivery ticket.
7. Observe loads for proper size and shape. Materials should have consistent color, complete aggregate coating, and a minimum of segregation.
8. Check that paver maintains a speed which will minimize stop and start operations.
9. Check that paver maintains correct line, grade and cross slope, and has the automatic controls adjusted to minimize screed "bounce" or "drift."
10. Check mat width, thickness, and yield.
11. Check that construction joints are tight and flush with adjacent surfaces.
12. Insure that mat has a uniform appearance and is free of longitudinal seams.
13. Check that rolling is as continuous as possible and at proper speed with drive wheel nearest paver. Discuss rolling pattern with project engineer, paving foreman or technician.
14. Cease vibratory rolling when checking or cracking occurs, or at a specified minimum temperature.
15. Finish rolling to remove all marks and bumps.
16. Monitor density tests to ensure adequate compaction.
17. Check surface with a rolling straightedge for ride quality.
18. Daily records include: workers, hours, equipment, lengths paved, course, depth, width, tonnage, yield, weather, temperatures, and problems encountered.

Aggregate Course and Truck Scale

1. Prior to placing base, verify that grade is true to correct cross-section and alignment. Check that subgrade or subbase is free of ruts, large stones, and excess dust.
2. Observe loads for proper size and makeup.
3. Generally, begin placement near the source of supply. Lifts should not exceed 8" of thickness unless otherwise approved by the engineer.
4. Check depth and yield (tons per linear feet) to assure uniform coverage.
5. Monitor base preparation needs: mixing by grader to eliminate segregation and hauling ruts, water to control dust and aid in obtaining compaction, and rolling to obtain density.
6. Obtain compaction of each lift before placing the next lift.
7. Collect, check, and initial the weigh ticket for each load as it arrives at the site.
8. Daily records include: workers, hours, equipment, location, lift thickness, quantity, and yield.

Culvert Pipe Installation

1. Review plans and specifications for culvert installation. PA One call complete?
2. Verify size, type, and length of pipe versus certification numbers.
3. Check pipe for approval stamp and inspect for any subsequent damage or defects.
4. Review control stakes and adjacent terrain for proper drainage.
5. Check trench for proper width and shoring needs, follow OSHA safety requirements.
6. Check bed for proper grade and compaction. Check shape of bed with template.
7. Place tongue end of concrete pipe in direction of flow and lap in metal pipe so that flow is overlap.
8. Check that concrete pipe joints are snug and lift holes plugged. Banding for corrugated metal pipe shall be installed in accordance with specifications.
9. Determine pay length while installing pipe by multiplying the number of sections by their nominal length.
10. Ensure that backfill material is free of large rocks and debris.
11. Check that backfill is placed in accordance with specifications or as directed by engineer.
12. When complete, verify that pipe is in proper alignment and undamaged.
13. Daily records include: trenching, placement and backfilling information, item, pay length, location, heat numbers, crew, equipment, and problems encountered.

Storm Sewer Installation

1. Review items 1 thru 6, 9 & 10 of “Culvert Pipe” and the guidelines below.
2. Check for potential conflicts with existing and proposed underground utilities.
3. Check that excavation and sewer installation begins at the outlet of proposed sewer and proceeds upstream. If existing underground utilities are in the area, the trench excavation should normally be complete between drainage structures before beginning installation of sewer pipe.
4. Ensure that joints and liftholes are sealed in accordance with the contract.
5. Check invert elevation and alignment of each section of pipe as installed from string line or laser beam.
6. Check that backfill material is “granular backfill” unless otherwise indicated in the contract.
7. Generally, determine pay length by measurement of storm sewer in place prior to or during backfilling. Adjust for end cut-offs after structures are in place.
8. Insure that bricks and concrete blocks are wetted before use.
9. Check that mortar is 3 parts sand and 1 part cement material.
10. Check contract requirements for mortar, backplastering, and curing.
11. Check that castings sit on a full bed of mortar or are poured integral.
12. Check contract requirements for cleaning and testing.
13. Daily records include: trenching, placement and backfilling information, item, pay length, location, structure numbers, crew, equipment, and problems encountered.

Grading

1. Review grading and erosion and control plans.
2. Inspect clearing and grubbing limits, and measure quantities. Check contract for disposal of firewood and debris.
3. Monitor salvaging of topsoil to ensure proper drainage and erosion control.
4. Insure unstable material below subgrade is undercut and measured for final pay. Check with project engineer to establish the need for undercut.
5. Ensure that all rock at subgrade elevation is undercut 6“.
6. Check that masonry walls, floors, and foundations; and pavement near subgrade elevation is broken down and removed to the depth specified below subgrade.
7. Intermix large stones, rock, and broken concrete with soil to prevent voids.
8. Ensure that the embankment is placed and compacted full width in layers normally not exceeding 8”.
9. Check for compaction and stability by visual observation of subgrade and the embankment under earth moving equipment or per the contract language.
10. Route hauling and leveling equipment over the full width of the embankment.
11. If required, enlist water and special compacting equipment.
12. Consideration must be given to continued drainage and erosion control throughout operations.
13. Check that culverts are “bridged”, as per specifications, with sufficient embankment to prevent damage from hauling equipment.
14. Check with engineer prior to permitting hauling over structures.
15. Daily records include: location, type of work, workers, hours, equipment, quantities, soil types, layer thickness, relative moisture, degree of compaction, information on rutting or displacement, weather conditions and problems encountered.

Seeding, Finishing, Etc…

1. Ensure the topsoil is placed on cut and fill slopes to the depth and locations designated in the plan.
2. Check that topsoil is relatively free of clumps, rocks, roots, etc., and is prepared suitably for seeding.
3. Check composition of delivered fertilizer and seed, and verify that requirements of contract are met.
4. Check that fertilizer and seed is applied at a rate dependent upon composition of supplied material.
5. Check that fertilizer is applied according to manufacturer's recommendations.
6. Ensure that seed is applied according to specifications.
7. Count, record, and dispose of empty fertilizer and seed bags daily. Collect all weigh and seed tickets.
8. Check that mulching, where specified, follows seeding within specified times. Verify that mulch material and application methods meet contract requirements.
9. Ensure that areas to be sodded are properly prepared. Sod shall consist of healthy, desirable grasses.
10. Check that all sod is "keyed" in, rolled, or lightly tamped. If placed in ditches or on steep slopes, it shall be pegged. Water as necessary for 10 days or as specified.
11. Check erosion mat for conformance with specification. Place as required, staple in full contact, bury all edges, and restore disturbed areas.
12. Monitor final finishing including: removal of all litter and debris, repair of damaged areas, and cleaning of all drainage structures.
13. Daily records include: location, type of work, estimated or final quantities, and material components.

Structures

GENERAL

1. Review field controls for horizontal and vertical alignment.
2. Review utility installations and railroad company requirements.
3. Check earth foundation for correct elevation and suitable bearing value.

PILING

1. Check and document the type, length, size, heat numbers, condition, and certification.
2. Check the layout for correct location.
3. Review driving operation for proper hammer, pile cap, cushion block, hammer operation, pile splices, and bearing formula.
4. Review subsurface exploration log with project engineer and anticipate driving characteristics.
5. Obtain minimum penetration and bearing. Do not over-drive. Contact engineer if penetration varies significantly from plan.
6. After driving, check placement and alignment and inspect for damage from driving.
7. Record unit, pile number, penetration data, driven length, cut-off length, and bearing formula.

FORMS

1. Check and document condition, location, alignment, elevations, dimension, and stability.

(Structures continued next page)

Structures *(continued)*

REINFORCEMENT

1. Require proper job-site storage.
2. Check condition, size, steel grade, length, number, spacing, form clearance, support, bar ties, mat tie down, lap, and embedment.
3. Check anchor bolt and conduit placement.
4. Record number, length, size, and grade of bars.

CONCRETE PLACEMENT

1. Check mix, air, slump, placement, and consolidation.
2. Check form alignment during pour.
3. Collect concrete delivery tickets, verify and initial entries. Record any addition of water, mixing revolutions, and time the truck completed discharge.
4. Be aware of the time concrete was batched and of allowable time for placement.
5. Check concrete pour and consolidation.
6. Check for proper curing and cold weather protection.
7. Check backfill restrictions and requirements.
8. Record workers, hours, equipment, pour location, volume, air, slump, and test cylinder data.

BEAMS AND GIRDERS

1. Make visual checks for in-transit and erection damage, alignment tolerances, defects, and dimensional requirements.
2. Require proper job-site storage, if not set in place on arrival.
3. Inspect bearing devices and girder seats.
4. Check in-place alignment, camber, anchor bolts, and tie downs.
5. Review field welding and bolting requirements.

(Structures continued next page)

Structures *(continued)*

DECKS

1. Before beginning pour, inspect all finishing and curing equipment for condition and adjustment. Perform "dry run" with finishing machinery. Check and record bar steel embedment and deck thickness. Attend pre-pour conference.
2. Perform items listed under "Concrete Placement" plus the following:
   (a) During the pour, continually check and record bar steel embedment and deck thickness, also observe deflection of finishing rails and forms. Alert contractor if problems develop.
   (b) Be aware of proper vibration procedure.
   (c) Inspect straight edging and surface texturing.
3. Check curing and cold weather protection.
4. Daily records include: pour location, volume, air, slump and problems encountered. Also, make necessary cylinders.

Geotextiles

1. Review geotextile specifications. Check for: protective shipping wrapper, tensile strength, elongation, permeability, puncture strength, apparent opening size, burst strength, abrasion resistance, ultraviolet resistance etc…
2. Check that geotextile is placed in the manner and at the location shown on the project plans.
3. Insure that the fabric is placed on a surface which is free of obstructions and debris.
4. While being placed, give consideration to overlap, sewing, or gluing. If overlapped, the fabric should be placed such that the preceding roll overlaps the following roll in the direction in which the fill material is being spread.
5. Insure that geotextile is covered within the time specified.
6. Insure that any sections damaged during installation are repaired using a piece of fabric large enough to cover the damaged area, and to meet overlap requirements.
7 Note that geotextile is usually paid for by measuring the square yards of area covered (not including overlap).
8. Consider additional inspection procedures that may be necessary for specific geotextile uses, such as: drainage, stabilization, separation, reinforcement, and erosion controls.

Bituminous Surface Treatment

1. Be familiar with the specifications and methods applicable to the work -- this type of construction proceeds rapidly!
2. Check that all testing equipment is available.
3. Check asphalt distributor and all other equipment to ensure that it meets specifications.
4. Check the condition and adjustment of the asphalt pump, spray bar, and spray nozzles. The asphalt pump should provide uniform pressure. The nozzles should be set uniformily at the proper angle from the axis of the spray bar. The height of the spary bar should provide correct overlap of the spray from each nozzle.
5. Check the motor graders, rollers, spreader boxes, etc., to ensure that they are in good operating condition.
6. Check that the roadway to be treated is smooth, compacted, and has a uniform grade and cross section. Existing surface should be clean and free of loose patches or excessive joint and crack sealing materials. Prelevel or grade uneven surfaces.
7. Inspect the stockpiled aggregate to determine the grading of the material. Aggregate should be damp at the time of loading onto trucks for hauling to the roadway. (Asphalt will not readily coat dry or dusty aggregate.)
8. Test the spray bar and nozzles immediately prior to starting the application.
9. Keep a record of each load applied, showing area treated, gallons spread, and temperature of the asphalt.
10. Check that cover stone is applied at the specified rate immediately after the application of the asphalt. Insure that the spread of asphalt is not extended beyond the area that can be covered within the allowed time.
11. Cover any areas where there are skips or omissions.
12. Check that rolling is conducted as soon as possible following application of the cover stone in order to properly imbed the cover stone in the asphalt.
13. Broom the surface after curing to remove any loose or excessive cover stone.
14. Daily records include: workers, hours, equipment, stations treated, materials used, depth, width, tonnage, yield, weather, temperatures and problems encountered.

PART 2
Road and Highway Maintenance Tables

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Superpave and Corresponding PennDOT Courses and Thickness

Mixture Comparison Chart		Superpave Material Thickness		
Superpave Paving Course	*Corresponding PennDOT Conventional Paving Course*	*Minimum Thickness*	*Maximum Thickness*	Maximum Construction Lift
Superpave 9.5mm Fine-Graded Wearing Course*	Typical ID Fine-Graded	1”	1.5”	1.5”
Superpave 9.5mm Wearing Course *	Typical ID-2 Wearing Course	1.5”	2”	2”
Superpave 12.5mm Wearing Course*	Coarse-Graded ID-2 Wearing	2”	3”	3”
Superpave 19mm Binder Course	Fine-Graded ID-2 Binder Course	2.5”	4.5”	4.5”
Superpave 25mm Binder Course	Typical ID-2 Binder Course	3”	5.5”	5.5”
Superpave 25mm Base Course	Typical BCBC	3”	as designed	as designed
Superpave 37.5mm Base Course	Course-Graded BCBC	4.5”	as designed	as designed

* When used as a wearing course, not for Scratch or Leveling. Recommended using 9.5mm for Scratch or Leveling, 60 to 110 Lb/sy

PG Grade Determination	
PG 58-28	Use where AC-10 was specified in the past (cold weather climates).. Do not use on steep down or up grades or in heavy truck traffic areas.
PG 64-22	Use where AC-20 was specified in the past (most common in Pennsylvania). Can be used in any part of the state under most traffic conditions.
PG 76-22	Use where Polymer Modified Asphalt Cement is specified. Can be used in any part of the State under heavy traffic conditions, at intersections, or at locations where rutting has occurred in the past.

For example, an asphalt classified as a PG 64-22 means that the asphalt will meet the high temperature physical property requirements of the pavement down to -8°F. PG 64-22 is the liquid asphalt (asphalt cement) that should be specified in most applications.

Placement Temperatures	
PG 58-22	260°F to 310°F
PG 64-22	265°F to 320°F
PG 76-22	285°F to 330°F

* Includes Warm and Hot Mix

What is Warm Mix Asphalt?

1. Warm Mix is a generic term for various technologies allowing asphalt paving materials to be produced and placed at lower temperatures.
2. The temperature of warm mix asphalt (WMA) must be below the maximum allowable temperature of Hot Mix asphalt (HMA). See below.
3. Warm mix allows some kind of an approved additive to be placed in the mix at the plant. The additive reduces the viscosity and increases the workability at a lower temperature. This allows lower mixing and placement/compaction temperatures.
4. Compaction is achieved at much lower temperatures. For additional information please consult your Districts Municipal Office, Districts Materials personnel or your supplier .

Skid Resistance Level (SRL) Determination Criteria

Initial or Current One-Way ADT	Initial or Current Two-Way ADT	SRL Desigation
Above 10,000	Above 20,000	E
2,501-10,000	5,000-20,000	H; Blend of E and M, Blend of E & G
1,501-2,500	3,001-5,000	G; Blend of H and M; Blend of E and L
501-1,500	1,001-3,00	M; Blend of H and L; Blend of G and L; Blend of E and L
0-500	0-1,000	L

Practical ESAL's Comparison (20 year life)	ESAL's = Trucks/Day
	0.0 to 0.3 mil = 0 to 40
1 truck/day = 7,300 ESAL's	0.3 to 3. mil = 40 to 400
10 trucks/day = 73,000 ESAL's	3. to 30. mil = 400 to 3,900
100 trucks/day = 730,000 ESAL's	over 30. mil = over 3,900

Note: Truck/Day calculations utilizing a 1 ESAL truck, however different truck configurations have different ESAL values.

Contact your District Municipal Services or Construction Office for assiastance if needed.

Lineal Feet Covered By A 1,000-Gallon Tank

	Gallons Per Square Yard																
	0.10	0,15	0.20	0.25	0.30	0.33	0.35	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.25	1.50	2.00
8	11,250	7,500	5,625	4,500	3,750	3,375	3,214	2,813	2,250	1,875	1,607	1,406	1,250	1,125	900	750	563
9	10,000	6,667	5,000	4,000	3,333	3,000	2,857	2,500	2,000	1,667	1,429	1,250	1,111	1,000	800	667	500
10	9,000	6,000	4,500	3,600	3,000	2,700	2,571	2,250	1,800	1,500	1,286	1,125	1,000	900	720	600	450
11	8,182	5,455	4,091	3,273	2,727	2,455	2,338	2,045	1,636	1,364	1,169	1,023	909	818	655	545	409
12	7,500	5,000	3,750	3,000	2,500	2,250	2,143	1,875	1,500	1,250	1,071	938	833	750	600	500	375
14	6,429	4,286	3,214	2,571	2,143	1,929	1,837	1,607	1,286	1,071	918	804	714	643	514	429	321
15	6,000	4,000	3,000	2,400	2,000	1,800	1,714	1,500	1,200	1,000	857	750	667	600	480	400	300
16	5,625	3,750	2,813	2,250	1,875	1,688	1,607	1,406	1,125	938	804	703	625	563	450	375	281
18	5,000	3,333	2,500	2,000	1,667	1,500	1,429	1,250	1,000	833	714	625	556	500	400	333	250
20	4,500	3,000	2,250	1,800	1,500	1,350	1,286	1,125	900	750	643	563	500	450	360	300	225
22	4,091	2,727	2,045	1,636	1,364	1,227	1,169	1,023	818	682	584	511	455	409	327	273	205
24	3,750	2,500	1,875	1,500	1,250	1,125	1,071	938	750	625	536	469	417	375	300	250	188
25	3,600	2,400	1,800	1,440	1,200	1,080	1,029	900	720	600	514	450	400	360	288	240	180
26	3,462	2,308	1,731	1,385	1,154	1,038	989	865	692	577	495	433	385	346	277	231	173
28	3,214	2,143	1,607	1,286	1,071	964	918	804	643	536	459	402	357	321	257	214	161
30	3,000	2,000	1,500	1,200	1,000	900	857	750	600	500	429	375	333	300	240	200	150

Gallons of Asphalt Required Per Mile for Various Application Rates

Road Width (Feet)	Gallons Per Square Yard																
	0.10	0.15	0.20	0.25	0.30	0.33	0.35	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.25	1.50	2.00
8	469	704	939	1,173	1,408	1,564	1,643	1,877	2,347	2,816	3,285	3,755	4,224	4,693	5,867	7,040	9,387
9	528	792	1,056	1,320	1,584	1,760	1,848	2,112	2,640	3,168	3,696	4,224	4,752	5,280	6,600	7,920	10,560
10	587	880	1,173	1,467	1,760	1,956	2,053	2,347	2,933	3,520	4,107	4,693	5,280	5,867	7,333	8,800	11,733
11	645	968	1,291	1,613	1,936	2,151	2,259	2,581	3,227	3,872	4,517	5,163	5,808	6,453	8,067	9,680	12,907
12	704	1,056	1,408	1,760	2,112	2,347	2,464	2,816	3,520	4,224	4,928	5,632	6,336	7,040	8,800	10,560	14,080
14	821	1,232	1,643	2,053	2,464	2,738	2,875	3,285	4,107	4,928	5,749	6,571	7,392	8,213	10,267	12,320	16,427
15	880	1,320	1,760	2,200	2,640	2,933	3,080	3,520	4,400	5,280	6,160	7,040	7,920	8,800	11,000	13,200	17,600
16	939	1,408	1,877	2,347	2,816	3,129	3,285	3,755	4,693	5,632	6,571	7,509	8,448	9,387	11,733	14,080	18,773
18	1,056	1,584	2,112	2,640	3,168	3,520	3,696	4,224	5,280	6,336	7,392	8,448	9,504	10,560	13,200	15,840	21,120
20	1,173	1,760	2,347	2,933	3,520	3,911	4,107	4,693	5,867	7,040	8,213	9,387	10,560	11,733	14,667	17,600	23,467
22	1,291	1,936	2,581	3,227	3,872	4,302	4,517	5,163	6,453	7,744	9,035	10,325	11,616	12,907	16,133	19,360	25,813
24	1,408	2,112	2,816	3,520	4,224	4,693	4,928	5,632	7,040	8,448	9,856	11,264	12,672	14,080	17,600	21,120	28,160
25	1,467	2,200	2,933	3,667	4,400	4,889	5,133	5,867	7,333	8,800	10,267	11,733	13,200	14,667	18,333	22,000	29,333
26	1,525	2,288	3,051	3,813	4,576	5,084	5,339	6,101	7,627	9,152	10,677	12,203	13,728	15,253	19,067	22,880	30,507
28	1,643	2,464	3,285	4,107	4,928	5,476	5,749	6,571	8,213	9,856	11,499	13,141	14,784	16,427	20,533	24,640	32,853
30	1,760	2,640	3,520	4,400	5,280	5,867	6,160	7,040	8,800	10,560	12,320	14,080	15,840	17,600	22,000	26,400	35,200

Tons of Aggregate Required Per Mile For Various Application Rates

Road Width (Feet)	Pounds Per Square Yard														
	3	5	7	8	10	12	15	20	25	30	35	40	45	50	100
8	7	12	16	19	23	28	35	47	59	70	82	94	106	117	235
9	8	13	18	21	26	32	40	53	66	79	92	106	119	132	264
10	9	15	21	23	29	35	44	59	73	88	103	117	132	147	293
11	10	16	23	26	32	39	48	65	81	97	113	129	145	161	323
12	11	18	25	28	35	42	53	70	88	106	123	141	158	176	352
14	12	21	29	33	41	49	62	82	103	123	144	164	185	205	411
15	13	22	31	35	44	53	66	88	110	132	154	176	198	220	440
16	14	23	33	38	47	56	70	94	117	141	164	188	211	235	469
18	16	26	37	42	53	63	79	106	132	158	185	211	238	264	528
20	18	29	41	47	59	70	88	117	147	176	205	235	264	293	587
22	19	32	45	52	65	77	97	129	161	194	226	258	290	323	645
24	21	35	49	56	70	84	106	141	176	211	246	282	317	352	704
25	22	37	51	59	73	88	110	147	183	220	257	293	330	367	733
26	23	38	53	61	76	92	114	153	191	229	267	305	343	381	763
28	25	41	57	66	82	99	123	164	205	246	287	329	370	411	821
30	26	44	62	70	88	106	132	176	220	264	308	352	396	440	880

Cubic Yards of Material Required Per 100 Lineal Feet

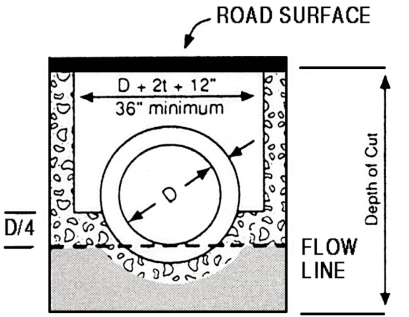
Road Width (Feet)	Cubic Yards of Loose Aggregate Required for Various Depths (Inches)														
	0.5”	0.75”	1.0”	1.5”	2.0”	2.5”	3.0”	3.5”	4.0”	4.5”	5.0”	6.0”	8.0”	10.0”	12.0”
8	1.2	1.9	2.5	3.7	4.9	6.2	7.4	8.6	9.9	11.1	12.3	14.8	19.8	24.7	29.6
9	1.4	2.1	2.8	4.2	5.6	6.9	8.3	9.7	11.1	12.5	13.9	16.7	22.2	27.8	33.3
10	1.5	2.3	3.1	4.6	6.2	7.7	9.3	10.8	12.3	13.9	15.4	18.5	24.7	30.9	37.0
11	1.7	2.5	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.0	20.4	27.2	34.0	40.7
12	1.9	2.8	3.7	5.6	7.4	9.3	11.1	13.0	14.8	16.7	18.5	22.2	29.6	37.0	44.4
14	2.2	3.2	4.3	6.5	8.6	10.8	13.0	15.1	17.3	19.4	21.6	25.9	34.6	43.2	51.9
15	2.3	3.5	4.6	6.9	9.3	11.6	13.9	16.2	18.5	20.8	23.1	27.8	37.0	46.3	55.6
16	2.5	3.7	4.9	7.4	9.9	12.3	14.8	17.3	19.8	22.2	24.7	29.6	39.5	49.4	59.3
18	2.8	4.2	5.6	8.3	11.1	13.9	16.7	19.4	22.2	25.0	27.8	33.3	44.4	55.6	66.7
20	3.1	4.6	6.2	9.3	12.3	15.4	18.5	21.6	24.7	27.8	30.9	37.0	49.4	61.7	74.1
22	3.4	5.1	6.8	10.2	13.6	17.0	20.4	23.8	27.2	30.6	34.0	40.7	54.3	67.9	81.5
24	3.7	5.6	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3	37.0	44.4	59.3	74.1	88.9
25	3.9	5.8	7.7	11.6	15.4	19.3	23.1	27.0	30.9	34.7	38.6	46.3	61.7	77.2	92.6
26	4.0	6.0	8.0	12.0	16.0	20.1	24.1	28.1	32.1	36.1	40.1	48.1	64.2	80.2	96.3
28	4.3	6.5	8.6	13.0	17.3	21.6	25.9	30.2	34.6	38.9	43.2	51.9	69.1	86.4	103.7
30	4.6	6.9	9.3	13.9	18.5	23.1	27.8	32.4	37.0	41.7	46.3	55.6	74.1	92.6	111.1

Pounds of Aggregate Required Per Square Yard

Pounds of Aggregate Per Cubic Yard	Pounds of Compacted Aggregate Per Square Yard for Various Depths (Inches)											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
1,800	50	100	150	200	250	300	350	400	450	500	550	600
1,900	53	106	158	211	264	317	369	422	475	528	581	633
2,000	56	111	167	222	278	333	389	444	500	556	611	667
2,100	58	117	175	233	292	350	408	467	525	583	642	700
2,200	61	122	183	244	306	367	428	489	550	611	672	733
2,300	64	128	192	256	319	383	447	511	575	639	703	767
2,400	67	133	200	267	333	400	467	533	600	667	733	800
2,500	69	139	208	278	347	417	486	556	625	694	764	833
2,600	72	144	217	289	361	433	506	578	650	722	794	867
2,700	75	150	225	300	375	450	525	600	675	750	825	900
2,800	78	156	233	311	389	467	544	622	700	778	856	933
2,900	81	161	242	322	403	483	564	644	725	806	886	967
3,000	83	167	250	333	417	500	583	667	750	833	917	1,000
3,100	86	172	258	344	431	517	603	689	775	861	947	1,033
3,200	89	178	267	356	444	533	622	711	800	889	978	1,067
3,300	92	183	275	367	458	550	642	733	825	917	1,008	1,100
3,400	94	189	283	378	472	567	661	756	850	944	1,039	1,133
3,500	97	194	292	389	486	583	681	778	875	972	1,069	1,167
3,600	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200

Cubic Yards of Material Required Per Foot For A Typical Culvert Installation

Depth of Cut to Flow Line (Feet)	Diameter (D) and Thickness (T) of Pipe (Inches)							
	D=12 T=2.0	D=15 T=2.25	D=18 T=2.5	D=24 T=3.0	D=30 T=3.5	D=36 T=4.0	D=42 T=4.5	D=48 T=5.0
2	0.19	0.16	0.12					
3	0.32	0.29	.025	0.23	0.18			
4	0.45	0.42	0.38	0.38	0.36	0.32	0.26	
5	0.59	0.56	0.52	0.54	0.54	0.53	0.49	0.42
6	0.62	0.69	0.65	0.69	0.72	0.74	0.73	0.68
7	0.85	0.82	0.78	0.85	0.90	0.95	0.96	0.94
8	0.99	0.96	0.92	1.00	1.09	1.16	1.19	1.20
9	1.12	1.09	1.05	1.16	1.27	1.36	1.43	1.46
10	1.25	1.22	1.18	1.31	1.45	1.57	1.66	1.72
11	1.39	1.36	1.32	1.47	1.63	1.78	1.90	1.98
12	1.52	1.49	1.45	1.62	1.81	1.98	2.13	2.24

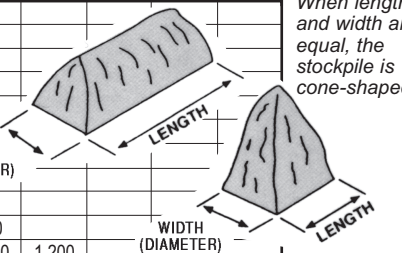


Storage Capacity (in Tons) of Cone- or Tent-Shaped Stockpiles of Crushed Stone

Length of Stockpile (Feet)	Base Width Diameter (Feet)													
	10	15	20	25	30	35	40	45	50	55	60	65	70	75
10	5													
15	11	19												
20	16	30	44											
25	21	42	65	86										
30	26	54	86	120	150									
35	32	66	110	150	200	240								
40	37	78	130	180	240	300	350							
45	42	89	150	220	290	360	440	500						
50	47	100	170	250	340	430	520	610	690					
55	53	110	190	280	380	490	600	710	820	910				
60	58	120	210	320	430	560	690	820	950	1,100	1,200			
65	63	140	230	350	480	620	770	920	1,100	1,200	1,400	1,500		
70	68	150	250	380	530	680	850	1,000	1.200	1,400	1,600	1,700	1,900	
75	74	160	270	410	570	750	940	1,100	1,300	1,500	1,800	2,000	2,100	2,300

For each additional 10 feet beyond the 75-foot length in this table, add the following values:

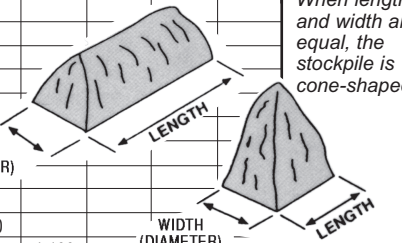
11	24	42	66	94	130	170	210	260	315	375	445	515	590



When length and width are equal, the stockpile is cone-shaped.

Storage Capacity (in Tons) of Cone- or Tent-Shaped Stockpiles of Sand or Gravel

Length of Stockpile (Feet)	Base Width Diameter (Feet)													
	10	15	20	25	30	35	40	45	50	55	60	65	70	75
10	5													
15	10	17												
20	14	27	39											
25	19	38	58	77										
30	24	48	77	110	130									
35	28	59	96	140	180	210								
40	33	70	120	170	220	270	320							
45	38	80	130	200	260	330	390	450						
50	43	91	150	220	300	380	470	540	620					
55	47	100	170	250	340	440	540	640	730	820				
60	52	110	190	280	390	500	620	740	850	960	1,100			
65	57	120	210	310	430	560	690	830	970	1,100	1,200	1,400		
70	61	130	230	340	470	610	770	930	1,100	1,200	1,400	1,600	1,700	
75	66	140	250	370	510	670	840	1,000	1,200	1,400	1,600	1,800	1,900	2,100
For each additional 10 feet beyond the 75-foot length in this table, add the following values:														
.	9	21	38	59	85	115	150	190	235	285	340	400	460	530



When length and width are equal, the stockpile is cone-shaped.

Square Yards of Road Surface for Various Road Widths

ROAD WIDTH (FEET)	SQUARE YARDS OF ROAD SURFACE		
	Per Lineal Foot	Per 100 Feet	Per Mile
6	0.67	66.67	3,520
7	0.78	77.78	4,107
8	0.89	88.89	4,693
9	1.00	100.00	5,280
10	1.11	111.11	5,867
11	1.22	122.22	6,453
12	1.33	133.33	7,040
13	1.44	144.44	7,627
14	1.56	155.56	8,213
15	1.67	166.67	8,800
16	1.78	177.78	9,387
17	1.89	188.89	9,973
18	2.00	200.00	10,560
20	2.22	222.22	11,733
22	2.44	244.44	12,907
24	2.67	266.67	14,080
25	2.78	277.78	14,667
26	2.89	288.89	15,253
28	3.11	311.11	16,427
30	3.33	333.33	17,600
32	3.56	355.56	18,773
34	3.78	377.78	19,947
36	4.00	400.00	21,120
38	4.22	422.22	22,293
40	4.44	444.44	23,467
50	5.56	555.56	29,333
60	6.67	666.67	35,200
70	7.78	777.78	41,067
75	8.33	833.33	44,000
80	8.89	888.89	46,933

Mowing and Spraying Strip Widths

If you have a strip of a certain width to mow or spray, how many acres are in one mile or how many miles must you travel to equal one acre?

43,560 SF = 1 Acre

STRIP WIDTH (FEET)	Approximate Acres in a Mile	Miles Traveled to Equal One Acre
1	0.12	8.25
2	0.24	4.13
3	0.36	2.75
4	0.48	2.06
5	0.61	1.65
6	0.73	1.38
7	0.85	1.18
8	0.97	1.03
9	1.09	0.92
10	1.21	0.83
12	1.45	0.69
14	1.70	0.59
16.5	2.00	0.50

Compacted Hot Mix

Depth Compacted (Inches)	Square Yards Per Ton
1.0	18.0
1.5	12.0
2.0	9.0
2.5	7.1
3.0	6.0

Compacted Weights of Various Materials

Type of Material	Pounds Per Cubic Foot	Pounds Per Cubic Yard	Apx. Pounds Per Sq. Yard Per 1" Depth
Trap Rock	122	3,300	92
	127	3,420	95
	131	3,530	98
Granite or Limestone	113	3,060	85
	118	3,180	88
	122	3,300	92
Sandstone	105	2,830	79
	109	2,950	82
	113	3,060	85
	118	3,180	88
Sand	105	2,830	79
	109	2,950	82
	113	3,060	85
	118	3,180	88
Slag	70	1,890	53
	83	2,240	62
	96	2,590	72
	109	2,950	82
Cement Bituminous	115	3,100	86
	130	3,510	97
	145	3,910	109
	160	4,320	120

Loose Weights of Various Materials

Type of Material	Pounds Per Cubic Foot	Pounds Per Cubic Yard	Apx. Pounds Per Sq. Yard Per 1" Depth
Trap Rock	96	2,590	72
	100	2,690	75
	103	2,780	77
Granite or Limestone	90	2,410	67
	93	2,500	69
	96	2,590	72
Sandstone	82	2,220	62
	86	2,320	64
	90	2,410	66
	93	2,500	70
Sand	97	2,630	73
	101	2,740	76
	106	2,850	79
	110	2,960	82
Slag	55	1,480	41
	65	1,760	49
	76	2,040	57
	86	2,320	64
Cement Bituminous	91	2,480	69
	100	2,700	75
	116	3,130	87
	128	3,460	96

Conversion Factors

LENGTH		
To Convert (A)	**To (B)**	**Multiply (A) By**
Inches	Feet	0.0833
Inches	Yards	0.028
Feet	Inches	12
Feet	Yards	0.33
Feet	Rods	0.06
Yards	Inches	36
Yards	Feet	3
Yards	Rods	0.18
Rods	Inches	198
Rods	Feet	16.5
Rods	Yards	5.5
Miles	Feet	5,280
Miles	Yards	1,760
Miles	Rods	320

AREA		
To Convert (A)	**To (B)**	**Multiply (A) By**
Square Inches	Square Feet	0.007
Square Feet	Square Inches	144
Square Feet	Square Yards	0.11
Square Yards	Square Inches	1,296
Square Yards	Square Feet	9
Square Yards	Square Rods	0.03
Square Rods	Square Feet	272.25
Square Rods	Square Yards	30.25
Acres	Square Feet	43,560
Acres	Square Yards	4,840
Acres	Square Rods	160

Conversion Factors

VOLUME		
To Convert (A)	**To (B)**	**Multiply (A) By**
Cubic Feet	Cubic Inches	1,728
Cubic Feet	Cubic Yards	0.04
Cubic Feet	Gallons	7.48
Cubic Yards	Cubic Feet	27
Cubic Yards	Gallons	202
Quarts	Pints	2
Quarts	Gallons	0.25
Gallons	Pints	8
Gallons	Quarts	4
Gallons	Cubic Feet	0.13

FORCE		
To Convert (A)	**To (B)**	**Multiply (A) By**
Ounces	Pounds	0.06
Pounds	Ounces	16
Tons (short)	Pounds	2,000
Tons (metric)	Pounds	2,204

VELOCITY		
To Convert (A)	**To (B)**	**Multiply (A) By**
Miles/Hour	Feet/Minute	88
Miles/Hour	Feet/Second	1.47

Conversion Factors

Common Fractions to Decimal Numbers

Fraction	Decimal Equivalent
1/2	0.50
1/3	0.33
2/3	0.67
1/4	0.25
2/4	0.50
3/4	0.75
1/5	0.20
2/5	0.40
3/5	0.60
4/5	0.80
1/6	0.17
2/6	0.33
3/6	0.50
4/6	0.67
5/6	0.83
1/7	0.14
2/7	0.29
3/7	0.43
4/7	0.57
5/7	0.71
6/7	0.86
1/8	0.13
2/8	0.25
3/8	0.38
4/8	0.50
5/8	0.63
6/8	0.75
7/8	0.88

Fraction	Decimal Equivalent
1/10	0.10
2/10	0.20
3/10	0.30
4/10	0.40
5/10	0.50
6/10	0.60
7/10	0.70
8/10	0.80
9/10	0.90
1/12	0.08
2/12	0.17
3/12	0.25
4/12	0.33
5/12	0.42
6/12	0.50
7/12	0.58
8/12	0.67
9/12	0.75
10/12	0.83
11/12	0.92
1/16	0.06
2/16	0.13
3/16	0.19
4/16	0.25
5/16	0.31
6/16	0.38
7/16	0.44
8/16	0.50
9/16	0.56
10/16	0.63
11/16	0.69
12/16	0.75
13/16	0.81
14/16	0.88
15/16	0.94

Perimeter, Area, and Volume Formulas

PERIMETER = P	
Scalene Triangle	P = a + b + c
Isosceles Triangle	P = 2a + b
Equilateral Triangle	P = 3s
Quadrilateral Triangle	P = a + b + c + d
Rectangle	P = 2l + 2w
Square	P = 4s
Circle	P = 3.14 x d

AREA = A	
Rectangle	A = lw
Square	A = lw or A = s^2
Parallelogram	A = bh
Triangle	A = 1/2 bh
Trapezoid	A = 1/2 h (b_1 + b_2)
Circle	A = 3.14 x r^2
Cube	A = $6e^2$

VOLUME = V	
Cylinder	V = bh
Rectangular Solid	V = lwh
Cube	V = e^3
Circular Cylinder	V = 3.14 x r^2 x h
Pyramid	V = 1/3 bh
Cone	V = 1/3 bh or 1/3 3.14r^2 h
Sphere	V = (4 x 3.14 x r^3)/3

PART 3

Asphalt Paving Inspection Check List

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Compaction 42
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Preliminary Responsibilities

DOCUMENT REVIEW

- ❑ Bid Specifications.
- ❑ Special Provisions.
- ❑ Construction Manual.
- ❑ Traffic Control Plan (TCP).

COORDINATION OF WORK

- ❑ Utility companies are contacted and work is coordinated.
- ❑ If necessary, manhole elevations are adjusted.
- ❑ Any planned road excavations are completed before paving begins.
- ❑ Local businesses' access times are arranged.
- ❑ Local businesses' entrances and exits are discussed.

FIELD REVIEW

- ❑ I am wearing appropriate safety gear.
- ❑ Necessary repair areas are marked.
- ❑ Necessary repairs are made before paving begins.

Milling

- ❑ Pavement is milled to proper depth.
- ❑ Milling equipment does not rip or tear the surface.
- ❑ Dust is controlled during milling.
- ❑ Check for traffic signal sensor loop detectors.
- ❑ Coordinate with Traffic Light maintenance provider before milling begins.

Equipment Inspections

HAUL TRUCKS

- ❑ Back-up alarms working.
- ❑ No fuels or oil leaks.
- ❑ Tarps are required.
- ❑ Releasing agent is drained completely before mix is placed in truck.
- ❑ Inspect hauling trucks for foreign debris each day before loading.

PAVER

- ❑ Flow control gates are adjusted to allow right amount of material flow.
- ❑ Screed surface is smooth.
- ❑ Leading edge of screed set slightly higher about 3/8 inch than trailing edge.
- ❑ If an extension is used, auger is same length as extension.
- ❑ Depth screws properly set at beginning of operation.
- ❑ Grade and slope set properly.
- ❑ If skis are used, sensing device is mounted between 6 1/2 to 11 1/2 feet

ROLLERS

- ❑ Steel-wheel rollers' drums are smooth.
- ❑ Scrapers and mats are in good condition.
- ❑ Steel-wheel rollers' nozzles are working properly.
- ❑ No oil or fuel leaks under roller.
- ❑ Pneumatic-tire rollers' tires properly inflated, within 5 psi of each other.
- ❑ Pneumatic-tire rollers' have a working weight capacity of at least 300 lbs per inch of width of tread.

HAND TOOLS

- ❑ Lutes are used for joint construction, not rakes.
- ❑ While in use, hand tools are cleaned with a putty knife, not diesel fuel.

Tack Coat

MATERIAL

- ❑ Approved type of tack coat is used as specified by contract documents.
- ❑ Tack has been sampled and submitted for testing.

PRELIMINARY

- ❑ Surface is clean and dry before application.
- ❑ Tack is heated within proper temperature range prior to application.

EQUIPMENT

- ❑ Nozzles are clean and unplugged.
- ❑ Nozzles angled in same direction.

APPLICATION

- ❑ Tack is applied evenly and uniformly.
- ❑ Tack all vertical faces.
- ❑ Tack is applied at specified application rate.
- ❑ More tack is not applied that can be covered in the same day.
- ❑ Traffic and dirt are kept off the tack coat.
- ❑ When emulsions are used, the material loses its water content before the mix is placed (turns from brown to black and becomes sticky and tacky).

Traffic Control

- ❑ Signs and devices used match traffic control plan.
- ❑ Set-up complies with the latest version of Publication 213.
- ❑ Flaggers MUST be trained.
- ❑ Flaggers do not hold traffic too long.
- ❑ Unsafe conditions, if any, are reported to supervisor.
- ❑ Signs are removed or covered when they no longer apply.

Weather Requirements

- ❑ Local specs checked for minimum air and surface temperature requirements.
- ❑ Any applicable calendar restrictions are observed.
- ❑ **Paving does not begin if rain is likely.**

Paving Operation

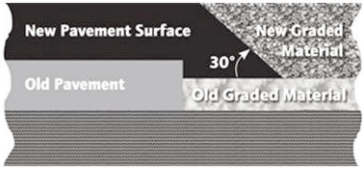
DELIVERY OF MIX

- ❑ Ticket collected from each haul truck.
- ❑ Time mix is received and where it is placed recorded on ticket.
- ❑ Mix meets minimum temperature requirement usually 260 to 285 degrees Fahrenheit.
- ❑ There are no lumps, blue smoke, or steam (indications that mix is too hot or cold. If so, may call for rejection).
- ❑ There are no uncoated particles, and the mix is not soupy, stiff or dull (indications of inadequate asphalt) If so, may call for rejection.
- ❑ There are no pockets of fine or coarse aggregates (indicates segregation) If so, may call for rejection.
- ❑ Station numbers noted to determine amount of material to be placed.
- ❑ Haul trucks maintain a constant supply of material to paver.

Placement of Mix

CONVENTION METHOD

- ❏ Haul truck stops 3 feet in front of paver.
- ❏ Check batch slip for proper mix design.
- ❏ Smooth and even contact between paver and haul trucks. Both rollers make contact. Paver does not bump the truck.
- ❏ Little, if any, material is dumped outside the hopper.
- ❏ Any spilled material is shoveled up before paver runs over it.
- ❏ Cold, hard mix does not get used.
- ❏ Mat is smooth, uniform and free of blemishes and segregation.
- ❏ Mat is placed at proper loose depth (mix will compact about 20%).
- ❏ If depth changes are necessary, they are made gradually.
- ❏ Shoulder at slope specified on typical section sheets.
- ❏ When paving an adjacent lane the paver slightly overlaps the first lane.
- ❏ Handwork is minimal at longitudinal joints.
- ❏ If a ski is used for controlling grade, it pulls straight, while remaining parallel to the longitudinal joint.
- ❏ Slope is properly set and checked with a slope board periodically.
- ❏ Safety Edge (Below)



Compaction

- ❏ When rollers reverse direction, they stop gradually and reverse smoothly without scuffing, pushing or marring the mat.
- ❏ Rollers do not stop on the hot mat (except to reverse direction).
- ❏ Rollers proceed in as straight a line as possible. Turns are smooth and gradual not sharp.
- ❏ On super elevations, rolling starts on low side, with each successive pass 6 to 12 inches to the high side.
- ❏ Density is checked and meets agency's minimum requirements.

Constructing Transverse Joints

- ❏ Material is cut away at a point where the required depth and slope are maintained.
- ❏ If paper is used, the paper extends the full length and width of the taper.
- ❏ Transition is formed at the proper taper.
- ❏ Surrounding pavement is clean before paving begins again.
- ❏ Face of joint is vertical.
- ❏ Joint face, and area where taper was made are tacked.
- ❏ Excess material is removed after paver goes by.
- ❏ Joint receives same compaction as the rest of the mat.
- ❏ Transition is smooth. Any high or low spots are corrected.

PART 4

Chip Seal Application Check List

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Preliminary Responsibilities

DOCUMENT REVIEW

- ❑ Bid Specifications
- ❑ Special Provisions
- ❑ Construction Manual
- ❑ Traffic Control Plan (TCP)

MATERIALS CHECKS

- ❑ Type of oil to be used is compatible with Aggregates
- ❑ Oil is from an approved source
- ❑ Oil is sampled and submitted for testing, if required
- ❑ All aggregates are close to the same size
- ❑ Aggregates are clean
- ❑ Aggregates used with emulsions are in surface-damp condition
- ❑ Test strip if required

Equipment Inspections

BROOM

- ❑ Bristles are proper length.
- ❑ Broom can be adjusted vertically to avoid excess pressure.

DISTRIBUTOR

- ❑ Distributor is properly calibrated.
- ❑ Nozzles are uniformly angled 15 to 30 degrees from spray bar.
- ❑ Spray checked for uniformity and overlap before applications begins.

AGGREGATE SPREADER

- ❑ Aggregate spreader is calibrated.
- ❑ Gate controls work properly.
- ❑ Scalping screen is in good condition.

ROLLERS

- ❑ Roller tire pressures comply with manufacturers specifications.
- ❑ Pressure is uniform from one tire to the next.

ALL EQUIPMENT

- ❑ All equipment is free of leaks.

Surface Preparation

- ❑ Existing surface inspected for drainage problems.
- ❑ Potholes are repaired and cracks are sealed.
- ❑ Rutting, bleeding, and corrugations are repaired.
- ❑ Existing surface is completely clean and dry.
- ❑ Do not apply scratch coat prior to the chip seal application.

Weather Requirements

- ❑ Air and surface temperatures meet agency requirements.
- ❑ Air and surface temperatures checked at coolest location on project.
- ❑ Application of oil does not begin if excessive wind will cause problems.
- ❑ Application of oil does not begin if rain is likely.

Determining Application Rates

- ❑ Agency guidelines and requirements are followed.
- ❑ More oil is applied to dried-out and porous surfaces.
- ❑ Less oil is applied to smooth, non-porous, and asphalt-rich surfaces.
- ❑ Less oil is applied on roads with high traffic volumes.

Checking Application Rates

OIL - METHOD A

- ❑ Weight of 1 square yard pan or non-woven geotextile material is recorded.
- ❑ 1 square yard pan or non-woven geotextile material placed on road surface.
- ❑ Distributor applies oil over pan or material
- ❑ Pan and oil or geotextile material and oil is weighed.
- ❑ Weight of pan or material without oil is subtracted from weight of pan or material with oil.

OIL - METHOD B

- ❑ Gallons of oil in distributor is measure while distributor is parked on level ground.
- ❑ Distributor applies oil to test section with known surface area.
- ❑ Gallons applied divided by square yards covered equal gallons per square yard.

AGGREGATES

- ❑ Weight of 1 square yard tarp is recorded.
- ❑ 1 square yard tarp placed on road surface.
- ❑ Chipper applies aggregates over tarp.
- ❑ Tarp and aggregates are weighed.
- ❑ Weight of tarp without aggregates is subtracted from weight of tarps with aggregates.

Traffic Control

- ❑ Signs and devices used match traffic control plan.
- ❑ Set-up complies with the latest version of Publication 213.
- ❑ Flaggers do not hold traffic too long.
- ❑ Unsafe conditions, if any, are reported to the supervisor.
- ❑ Pilot car leads traffic slowly [25 mph or less] over fresh chip seals.
- ❑ Signs are removed or covered when they no longer apply.

Oil Application

- ❑ Application starts and stops with neat, straight edges.
- ❑ Application starts and stops on building paper.
- ❑ Application appears uniform.
- ❑ Application is stopped as soon as problems are detected.

Aggregate Application

- ❑ Enough trucks are on hand to keep a steady supply of chips for the spreader.
- ❑ Application starts and stops with neat, straight edges.
- ❑ Application starts and stops on building paper.
- ❑ Aggregate spreader follows closely [30 yards or less] behind disributor when emulsion is used.
- ❑ Spreader travels slowly enough to avoid aggregates rolling when they hit the surface.
- ❑ No oil is on top of the Aggregates.

Rolling

- ❑ Rollers follow closely behind the Aggregate spreader.
- ❑ Entire surface is rolled.
- ❑ Rollers travel slowly 5 to 6 mph.
- ❑ Stops and turns are made gradually.
- ❑ Use sufficient rollers to cover width of stone spread during the first pass.

Truck Operation

- ❑ Trucks are staggered across fresh seal coat to avoid driving over the same area.
- ❑ Trucks travel slowly on fresh seal.
- ❑ Stops and turns are made gradually.
- ❑ Truck operators avoid driving over exposed oil.

Longitudinal Joints

- ❑ Meet line is only as wide as spray from end nozzle-about 8 inches.
- ❑ Distributor lines up so that end nozzle sprays the meet line.
- ❑ Meet lines are not made in wheel paths.
- ❑ Meet lines are made at center of road, center of lane, or edge of lane.
- ❑ Meet lines are not left uncovered overnight.

Transverse Joints

- ❑ All oil applications begin and end on building paper.
- ❑ All Aggregate applications begin and end on building paper.
- ❑ Building paper is disposed of properly.

Brooming

- ❑ Brooming begins as soon as possible.
- ❑ Brooming does not begin until sufficient bond has formed between oil and chips.
- ❑ Brooming does not dislodge aggregate.

Opening Chip Seal to Traffic

- ❑ Traffic travels slowly [25 mph or less] over fresh seal coat.
- ❑ Reduced speed limit signs are used when pilot cars are not used.

Common Problems and Solutions

1. Excessive splattering of oil:
   Spray pressure too high
2. Non-uniform oil application:

   Spray pressure too low; clogged noz zles.
3. Concentrations of oil:

   Leak in distributor plumbing;
   Excessive application rate.
4. Exposed oil after Aggregate application:

   Clogged or malfunctioning gate.
5. Excessive Aggregates:
   Malfunctioning gate;
   Overloading the spreader.
6. Oil on top of Aggregate:
   Spreader speed too fast improper truck or roller operation.
7. Concentration of oil in wheel only:
   Traffic on too soon or excessive application rate.

PART 5

Concrete Paving Check List

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Concrete Paving

1. Subgrade

(a) Check that base is graded and compacted properly.

(b) Any soft spots in base have been corrected

(c) Properly referenced for line and grade

(d) Trimmed to correct elevation and cross-slope using outside control from referenced lines (string line)

(e) Low points are properly located and marked

2. Review field controls for line and grade and become familiar with paving sequence.

3. Verify that utilities work and conduits are complete. Pre-locate utility fixtures to be poured in pavement.

4. Load transfer devices

(a) Placed within tolerances

(b) Firmly fastened down

(c) Correctly located

(d) Locations marked for saw crew

(e) Properly lubricated

(f) Dowels correct size and length

(g) Dowels located parallel to the longitudinal axis

5. Grade moist before placing concrete

6. Check the following equipment

(a) Paver

(1) Check hydraulic vibrators for oil leaks

(2) Assure all vibrators working properly

(3) Check Bars inserters correctly

(4) Correct width

(b) Texturing equipment

(c) Curing machine

(d) Air Meters

7. Have all ADA issues been addressed

8. Verify Concrete mix design

(a) Prescription mix or reviewed by engineer

(b) Class and percent of fly ash (when included)

(c) Admixtures

(d) Admixture proportions

(e) Water/cement ratio

(f) Slump

(g) Target air

(h) Strength

9. Paving Gaps

(a) Properly located and marked

(b) Payment procedures agreed upon

10. All driveways located and marked

11. Concrete delivery when mixed in a central plant

(a) High early loads noted

(b) Random check of discharge within time limits

12. Transverse and longitudinal joint layout discussed and agreed with contractor

(a) Joint spacing is proper for thickness specified

(b) Length to width ratios not exceeded

(c) Acute angles greater that 60 degrees

13. Concrete delivery when mixed in a transit/truck mixer

(a) Concrete tickets

(a) Tickets with each load

(a) All information on each ticket

(b) Amount of added water documented

(c) When water is added, is water/cement ratio exceeded

(d) Transit/truck mixers using the correct number of revolutions before discharging and after adding water and/or admixtures

(e) High early loads noted

14. During Concrete placement

(a) Check temperature of concrete within specification

(b) Check air temperatures

(c) Placed so minimum rehandling is required

(d) Signs of segregation

(e) Slump (consistency) visually similar for each load

(f) Discharge complete within specified time limits

(g) All concrete removed from non-agitating trucks

(h) Foot prints in fresh concrete vibrated (when occurring behind screed)

(i) When placing a transverse construction joint, is it at least four (4) feet from any transverse sawed (weakened plane) contraction joint

(j) Proper vibrations performed around manholes, inlets, etc.

(k) Proper operation of hand/spud vibrators

15. Finished pavement

(a) Proper width

(b) Proper thickness (using probing technique)

(c) Proper crown

(d) Proper super-elevation (when required)

(e) Edge slump within specifications

16. Testing

(a) Taking air tests per specifications

(b) Making cylinders for open to traffic

(c) Making cylinders for strength verifications

(d) Handling cylinders per specifications

(e) Taking slump tests if required per specifications

17. Longitudinal construction joints

(a) Properly located

(b) At lane lines (unless otherwise specified)

(c) Accommodation for manholes, etc.

18. Tie bars (when required)

(a) Inserted by approved method

(b) Inserted at proper location

(c) Epoxy coated

(d) Correct size

(e) Correct length

(f) Correct depth

(g) Correct spacing

(h) Proper treatment at transverse joints (either left out or not bent out)

19. Longitudinal sawed (weakened plane) joints

(a) Properly located

(b) Accommodation for manholes, etc.

(c) At lane lines (unless otherwise specified)

20. Transverse sawed (weakened plane) joints

(a) Properly located and marked

(b) Manholes, inlets, etc. accommodated

(c) Matches adjacent joints

(d) Matches tolerances for load transfer devices

21. Expansion joints (Pre-formed joint filler material placed as required on the plans)

22. Paver leaving an acceptable finish

23. Any hand finishing required

24. Straight-edging shows smoothness within tolerance

25. Any water being added to the surface to assist finishing

26. Burlap drag being kept at proper moisture (if being used)

27. Stationing being stamped into the pavement at the correct location (when required)

28. Texturing consistent

29. Cold weather protection required (contractor & municipality agree on basis for determining low temperature)

30. Material available to protect the pavement from rain.

31. Curing

(a) Cure placed within the specified time

(b) Application rate correct

(c) Placed on both vertical and horizontal surface

(d) Been approved

32. Check Joint Sawing Operation

(a) Saw joints been properly located and marked

(b) Within specified tolerance over load transfer devices (if specified)

(c) Joints sawed before cracking occurs

(d) Spalling occurring when joints are sawed.

(e) Proper width and depth

(f) Accommodate manholes, inlets, etc.

33. Sealing

(a) Concrete cured properly before sealing starts

(b) Approved materials

(c) Sealant placed to the specified tolerances

(d) Material recessed 3/16 of an inch

34. Pavement strength at 3000 PSI before opening to traffic

Sidewalks, Bikeways, Curb and Gutter

1. Subgrade

(a) Graded and compacted properly

(b) Soft spots identified and corrected

(c) Cross slope, elevation, and alignment correct

2. Reinforcing

(a) Required

(b) If so, what kind

(c) Correctly placed

3. Forms (when used)

(a) Set to proper line and elevation

(b) Set per grade stakes

(c) Firmly set and staked

(d) Correct dimensions

(e) Lightly oiled for concrete release

(f) Correctly set for inlet sections, handicap ramps and driveways

(g) Correctly set to handle all drainage per plan typical section

4. Placing integral or non-integral curb & gutter

(a) Has grade been trimmed to correct cross slop and elevation

(b) Is gradeline correct per grade stakes

(c) Are inlet sections, handicap ramps, and driveways correctly located and marked

(d) Proper drainage to inlets

(e) Is pan being constructed to spill or catch per typical section.

(f) Is alignment correct

(g) Does extruded section meet plan typical

5. Concrete

(a) Approved Class

(b) Test requirements being met

(c) Acceptable finish being achieved

(d) Properly consolidated

(e) Grade moist before placing concrete

(f) Finish accomplished without use of water

(g) Curing compound of an approved type, applied at appropriate time and rate

(h) Cold weather protection necessary

6. Joints

(a) Edged where required

(b) Expansion material of correct type placed where required

(c) Expansion material extending full depth

(d) Types and locations match joints in adjacent concrete

(e) Transverse type per plan

(f) Expansion material an approved type

7. Is backfill being started at correct time (verify if cure time or proper strength)

Forms

1. Forms mortar tight and sufficiently rigid to prevent excessive deflections.
2. Metal forms of adequate thickness and design to remain true to shape
3. Metal forms present a smooth surface and the joints align properly
4. Inside surfaces cleaned of all dirt, mortar, and foreign materials
5. Acceptable form oil is being used
6. All materials, (e.g. conduits, drains, utility block-outs, anchoring devices, etc.) to be embedded placed and adequately secured
7. Backforms being used properly
8. All dirt, chips, sawdust, water, or other foreign materials been removed from within the forms
9. Wood forms oiled or moistened prior to concrete placement
10. Concrete obtained required strength and/or minimum elapsed time per specifications prior to form removal

Flowable Fill

CONSTRUCTION

Placement

1. If necessary, construct formwork of adequate strength to withstand lateral pressure exerted by fluid material (PUB 408).
2. Do not place material through flowing water. Remove and replace any flowable fill damaged by water or rainfall.
3. Verify that there are no lumps in the material. If lumps are present they should be broken up.
4. Verify that all bleed water has dissipated prior to placing next lift of material.
5. Protect surface of material from frost, erosion, or other damage with an approved material

- *Structural Backfill* – Place flowable backfill in lifts to prevent lateral pressures from exceeding the resistance capacity of the structure. Protect structure drains from contamination of flowable backfill materials with appropriate geotextile material. Protect structure, utilities, etc. from movement or misalignment during placing of material.
- *Pipe Bedding & Backfill* – Place adequate support to provide minimum required bedding from trench bottom to bottom of pipe. Protect pipe from backfill material intrusion by wrapping appropriate geotextile material around pipe. Prevent floating of pipe by placing fill material in lifts or with sand bags, etc. to ballast the pipe until lift is set.
- *Utility Trench Backfill* – Provide adequate tie downs or weights to prevent pipe from floating during material placement.

Opening the Pavement to Traffic

- For Types A, B, and C material do not open to traffic until at least one hour after bleed water has dissipated and as allowed by the Representative.
- For Type D material open to traffic as approved by the Representative.

Pervious Concrete

CONSTRUCTION

Placement - Manual

1. Ensure that sub-grade and base material has been properly prepared and possesses suitable permeability.
2. Base material should be level (free of ruts) and moistened prior to concrete placement.
3. Forms should be of adequate strength to support placing equipment. Enough pins/stakes should be used to prevent lateral movement of forms.
4. Concrete should be placed as quickly as possible and as close to its final position as practical.
5. Pumping is not recommended.
6. Concrete should be placed “high” and compacted to proper grade. A roller screed is recommended for placement purposes.
7. Additional compaction may be required along the form edges to maintain structural integrity after the forms have been removed.
8. Jointing in green concrete may be accomplished with a concrete saw or through the use of a jointing tool referred to as a “pizza cutter” (preferred method).
9. Joint depth to be D/3 or D/4.
10. Joint spacing should follow the recommendation of the project designer.

CURING

1. Curing should commence almost immediately (within 20 minutes) after concrete has been placed and jointed.
2. Traditional membrane curing compounds are not recommended.
3. A 6 mil. (or thicker) polyethylene sheet should be used for curing purposes. Misting the surface of the concrete prior to placement of the plastic is suggested if the concrete has lost its sheen.
4. The cover should be secured to ensure the concrete remains covered. Dirt, sand or other granular materials are not recommended.
5. Plastic should remain in place for a minimum of 7 days. If supplementary materials are used in the concrete mix, cure time may be extended to 10 days.
6. The pavement should not be trafficked during the curing period.
7. Cold/Hot weather protection techniques should be applied as necessary.

"SAFETY IS NO ACCIDENT."

Here is a link to available training:

http://www.toolboxtopics.com/Construction/index.htm

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DEPARTMENT OF TRANSPORTATION

Pennsylvania Aggregates and Concrete Association

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PENNSYLVANIA CHAPTER

PAAMA

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